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मानक

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IS/ISO 11843-3 (2003): Capability of Detection, Part 3: Methodology for Determination of the Critical Value for the Response Variable When no Calibration Data are Used [MSD 3: Statistical Methods for Quality and Reliability]



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भारतीय मानक

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भाग 3 अंशशोधन आँकड़े प्रयुक्त न किये जाने की स्थिति में  
अनुक्रिया चर का संवेदी मान ज्ञात करने की पद्धति

*Indian Standard*

**CAPABILITY OF DETECTION**

**PART 3 METHODOLOGY FOR DETERMINATION OF THE CRITICAL VALUE FOR  
THE RESPONSE VARIABLE WHEN NO CALIBRATION DATA ARE USED**

ICS 03.120.30; 17.020

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**BUREAU OF INDIAN STANDARDS**  
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## NATIONAL FOREWORD

This Indian Standard (Part 3) which is identical with ISO 11843-3 : 2003 'Capability of detection — Part 3: Methodology for determination of the critical value for the response variable when no calibration data are used' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Statistical Methods for Quality and Reliability Sectional Committee and approval of the Management and Systems Division Council.

An ideal requirement for the capability of detection with respect to a selected state variable would be that the actual state of every observed system can be classified with certainty as either equal to or different from its basic state. However, due to systematic and random distortions, this ideal requirement cannot be satisfied because:

- in reality all reference states, including the basic state, are never known in terms of the state variable. Hence, all states can only be correctly characterized in terms of differences from basic state, that is, in terms of the net state variable.
- the calibrations and the processes of sampling and sample preparation add random variation to the measurement results.

In this standard, the symbol  $\alpha$  is used as for the probability of detecting (erroneously) that a system is not in the basic state.

The text of ISO Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

- a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.
- b) Comma (,) has been used as a decimal marker in the International Standard while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their respective places are listed below along with their degree of equivalence for the edition indicated:

<i>International Standard</i>	<i>Corresponding Indian Standard</i>	<i>Degree of Equivalence</i>
ISO 3534-1 <sup>1)</sup> Statistics — Vocabulary and symbols — Part 1: Probability and general statistical terms	IS 7920 (Part 1) : 2008 Statistics — Vocabulary and symbols: Part 1 Probability and general statistical terms ( <i>third revision</i> )	Technically Equivalent
ISO 5479 : 1997 Statistical interpretation of data — Tests for departure from normal distribution	IS 6200 (Part 3) : 1983 Statistical tests of significance: Part 3 tests for Normality ( <i>first revision</i> )	do
ISO 5725-2 : 1994 Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of	IS 15393 (Part 2) : 2003 Accuracy (trueness and precision) of measurement methods and results: Part 2 Basic method for the	Identical

<sup>1)</sup>Since revised in 2006.

*Indian Standard***CAPABILITY OF DETECTION****PART 3 METHODOLOGY FOR DETERMINATION OF THE CRITICAL VALUE FOR THE RESPONSE VARIABLE WHEN NO CALIBRATION DATA ARE USED****1 Scope**

This part of ISO 11843 gives a method of estimating the critical value of the response variable from the mean and standard deviation of repeated measurements of the reference state in certain situations (see 5.1) in which the value of the net state variable is zero, for all reasonable and foreseeable purposes. Hence, it can be decided whether values of the response variable in an actual state (or test sample) are above the range of values attributable to the reference state.

General procedures for determination of critical values of the response variable and the net state variable and of the minimum detectable value have been given in ISO 11843-2. Those procedures are applicable in situations in which there is relevant straight-line calibration and the residual standard deviation of the measured responses is either constant or is a linear function of the net state variable. The procedure given in this part of ISO 11843 for the determination of the critical value of the response variable only is recommended for situations in which no calibration data are used. The distribution of data is assumed to be normal or near-normal.

The procedure given in this part of ISO 11843 is recommended for situations in which it is difficult to obtain a large amount of the actual states although a large amount of the basic state can be prepared.

**2 Normative references**

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3534-1, *Statistics — Vocabulary and symbols — Part 1: Probability and general statistical terms*

ISO 3534-2, *Statistics — Vocabulary and symbols — Part 2: Statistical quality control*

ISO 3534-3, *Statistics — Vocabulary and symbols — Part 3: Design of experiments*

ISO 5479:1997, *Statistical interpretation of data — Tests for departure from normal distribution*

ISO 5725-2:1994, *Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*

ISO 11095:1996, *Linear calibration using reference materials*

ISO 11843-1:1997, *Capability of detection — Part 1: Terms and definitions*

ISO 11843-2:2000, *Capability of detection — Part 2: Methodology in the linear calibration case*

ISO Guide 30, *Terms and definitions used in connection with reference materials*



### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3534 (all parts), ISO Guide 30, ISO 5479, ISO 5725-2, ISO 11095 and ISO 11843-1 apply.

### 4 Experimental design

#### 4.1 General

The measurement method is assumed to be standardized and known to have been calibrated for measurements of a similar type, although calibration under the specific conditions being studied and at very low levels of the net state variable has not been undertaken or is not possible. The same complete measurement method shall be used for all replicated measurements of the reference state in which the state variable is zero as well as for actual states (test samples) within the measurement series for which a critical value of the response variable is required.

Measurements of actual states shall be randomized among the measurements of the basic state.

Negative values of the response variable shall not be discarded or altered if these arise. For example, negative values shall not be replaced by zeros.

#### 4.2 Choice of the reference state in which the value of the net state variable is zero

One of the assumptions in the procedure described in this part of ISO 11843 is that the value of the net state variable is zero in the reference state chosen. The certainty that can be expected in relation to such an assertion is discussed in ISO 11843-2:2000, Subclause 4.1: in reality, reference states are not known in absolute terms of the state variable but only in terms of differences from a (hypothetical) basic state. For this part of ISO 11843, it is sufficient for the reference level to be well below that likely to be measured by the method being used.

In cases in which the basic state is represented by a preparation of a reference material, the composition should be as close as possible to the composition of the material to be measured, i.e. in analytical chemistry the blank matrix material chosen should be very similar in every way to, if not identical with, the samples being examined in that measurement series. Influences due to the presence of other substances or elements, or due to the physical state of samples, can be highly significant. In particular, when solutions are being investigated, the use of pure solvents rather than the solvent extracts normally encountered in the measurement method is unacceptable.

#### 4.3 Replication

##### 4.3.1 Number of replications, $J$

The response from the method used on the basic state shall be measured for a sufficient number of replicates  $J$  of the entire procedure so as to give a good estimate of the mean and of the standard deviation. It is important to have sufficient data to examine the distribution of data to see whether the response variable is normally, or near-normally, distributed. About 30 measurements should usually ensure that the estimate of the standard deviation will not differ more than 30 % from the true standard deviation with approximately 95 % probability.

NOTE In some situations, it is not possible to perform the number of measurements outlined above because of constraints on the amount of material available or for other reasons. In such situations, the estimate of the standard deviation obtained is markedly uncertain. When such an estimate  $s$  (see  $s_b$  in 5.2) of a true standard deviation  $\sigma$  is to be made, conclusions can be drawn as to the range about the interval based on  $s$  within which the estimate of  $\sigma$  can be expected to lie with prespecified probability  $1 - \alpha$ . This is a statistical problem usually solved (if assumption of normality is valid and  $s$  is the sample standard deviation) by the use of the chi-squared distribution for the number of results on which the estimate of  $s$  was based to give a confidence interval for the value of  $\sigma$  of

$$s \sqrt{\frac{v}{\chi^2_{1-\frac{\alpha}{2}}(v)}} < \sigma < s \sqrt{\frac{v}{\chi^2_{\frac{\alpha}{2}}(v)}}$$

where  $v = J - 1$ , values of quantiles of  $\chi^2$ -distribution are obtainable from standard tables and  $\alpha$  is as defined in the introduction.

Replications of measurements  $K$  on the actual states (test samples) using the entire method will lower the critical value of the response variable to some extent [see Equation (4)], although cost constraints will have to be carefully considered.

#### 4.3.2 Uniformity of replication

When taking samples of the basic state in order to measure the response variable, it is essential to follow in every way the sampling procedure in the overall method.

If standard reference materials are available, they should be used because their homogeneity will have been carefully studied.

The possibilities of some surface phenomena, of electrostatic effects, of settling-out, etc., giving non-identical samples should always be borne in mind.

#### 4.3.3 Possible disturbing factors

Variation of possible disturbing factors during the runs should be minimized, as outlined in ISO 11843-2:2000, Subclause 4.1.

## 5 Computation of the critical value of the response variable $y_c$

### 5.1 Basic method

ISO 11843-1 defines the critical value  $y_c$  as the value of the response variable  $y$  such that, if it is exceeded, the decision will be made that the system is not in the basic state. The critical value is chosen so that, when the system is in the basic state, this decision will be made with only a small probability  $\alpha$ . In other words, the critical value is the minimum significant value of a measurement or signal, applied as a discriminator against background (noise).

The decision “detected” or “not detected” is made by comparison of the arithmetic mean of the determinations obtained for the actual state  $\bar{y}_a$  with the critical value  $y_c$  of the respective distribution. The probability that the arithmetic mean of measured values  $\bar{y}_a$  exceeds the critical value  $y_c$  for the distribution in the basic state ( $x = 0$ ) should be less than or equal to an appropriate pre-selected probability  $\alpha$ .

The critical value  $y_c$  of the response variable can be expressed generally as follows:

$$P(\bar{y}_a > y_c \mid x = 0) \leq \alpha \tag{1}$$

NOTE  $P(\bar{y}_a > y_c \mid x = 0)$  is the probability that  $\bar{y}_a > y_c$  under the condition that  $x = 0$ .

The definition may be stated as an equality, although the inequality accommodates discrete distributions, such as the Poisson distribution, for which not all values of  $\alpha$  are possible.

If

- a)  $y$  is normally distributed with standard deviation  $\sigma_0$ ,
- b) samples of actual states are as homogeneous as possible,
- c) the measurements are unbiased,



the critical value of the response variable is given by the following simplified expression of Equation (1):

$$y_c = \bar{y}_b \pm z_{1-\alpha} \sigma_0 \sqrt{\frac{1}{J} + \frac{1}{K}} \tag{2}$$

where

- $z_{1-\alpha}$  represents the  $(1 - \alpha)$ -quantile of the standard normal variable;
- $\sigma_0$  is the standard deviation of the net signal (or concentration) under the null hypothesis (true value  $x = 0$ );
- $J$  is the number of replicate determinations of the basic state;
- $\bar{y}_b$  is the arithmetic mean of those replications;
- $K$  is the number of determinations to be made on the actual state.

NOTE The sign + is used when the response variable increases with increasing level of the net state variable and the sign – is used when the response variable decreases with increasing level of the net state variable.

If  $\sigma_0$  is estimated by  $s_0$ , based on  $\nu$  degrees of freedom,  $z_{1-\alpha}$  shall be replaced by the corresponding quantile of Student's  $t$ -distribution, i.e.

$$y_c = \bar{y}_b \pm t_{1-\alpha}(\nu) s_0 \sqrt{\frac{1}{J} + \frac{1}{K}} \tag{3}$$

NOTE The sign + or – is used in the same manner as for Equation (2).

When the value of the state variable in the basic state is known, for all reasonable and foreseeable purposes, to be zero, i.e. the “baseline” for the response variable is known without significant error, then  $\sigma_0 = \sigma_b$ , the latter being estimated through  $s_b$ , the standard deviation of the replicate determinations of the response variable in the basic state. This is the situation addressed in this part of ISO 11843. It is one of several ways in which an experimental estimate of  $\sigma_0$  can be obtained.

## 5.2 Practical calculation

The replicated measurements of the response in the basic state should be examined for non-normality of distribution using such techniques as are described in ISO 5479, supplemented by any other available techniques.

For the purposes of this part of ISO 11843,  $J$  replicate measurements of the response of the basic state are made, within a measurement series, so that the mean value of  $y$ , given by

$$\bar{y}_b = \frac{\sum_{j=1}^J y_j}{J}$$

is the estimate of the expectation  $y_0$  of  $y$ , and the sample standard deviation of  $y$ , given by

$$s_b = \sqrt{\frac{\sum_{j=1}^J (y_j - \bar{y}_b)^2}{J-1}}$$

is the estimate of  $\sigma_b$ .

Thus a good estimate of the critical value of the response variable is given by

$$y_c = \bar{y}_b \pm t_{1-\alpha}(\nu) s_b \sqrt{\frac{1}{J} + \frac{1}{K}} \quad (4)$$

where the number of degrees of freedom  $\nu = J - 1$ . The statistical test is one-sided,  $\alpha$  is usually taken as 0,05 as recommended in ISO 11843-1, and the corresponding quantile of Student's  $t$ -distribution is obtained from standard tables.

NOTE The sign + or - is used in the same manner as for Equation (2).

Equation (5) applies directly to the situation in which a single determination is made on the test sample:

$$y_c = \bar{y}_b \pm t_{1-\alpha}(\nu) s_b \sqrt{\frac{1}{J} + 1} \quad (5)$$

NOTE The sign + or - is used in the same manner as for Equation (2).

### 5.3 Reporting and use of the critical value

The number of measurements of the response variable in the basic state  $J$  shall be stated together with the standard deviation  $s_b$  for that series. The number of replications of the response variable in the actual state  $K$  shall also be reported. The chosen value of  $\alpha$  shall be stated (usually 0,05). The critical value calculated for the specified number of replications of the response variable in the basic state and actual state shall be stated. These are conveniently set out in tabular form in Table 1.

**Table 1 — Critical value of the response variable and its corresponding experimental parameters**

Number of replicates of the response variable in the basic state	$J$
Number of replicates of the response in an actual state	$K$
Value of $\alpha$ chosen (default value: 0,05)	$\alpha$
Mean of the response variable in the basic state	$\bar{y}_b$
Mean of the response in the actual state	$\bar{y}_a$
Standard deviation of the response variable in the basic state	$s_b$
Critical value for the response variable derived by the simplified method of this part of ISO 11843 in which no calibration data are used	$y_c$

If the average of the  $K$  replicate determinations in the actual state is not greater than the critical value, it can be stated that no difference could be shown between the actual state and the basic state. However, the average result for the actual state shall be reported as found. It shall not be reported as zero.

## Annex A (normative)

### Symbols used in this part of ISO 11843

$b_2$	kurtosis test statistic
$J$	number of replications of measurements of the response variable in the basic state in which the state variable is zero (blank matrix)
$j = 1, 2, \dots, J$	variable identifying the preparations performed on the basic state in which the state variable is zero (blank matrix)
$K$	number of replications of measurements of the responses of the actual state (sample)
$P$	probability
$s$	estimated standard deviation of response variable
$s_b$	estimated standard deviation of the basic state in which the state variable is zero (blank matrix)
$s_0$	estimated standard deviation of measured response of the basic state
$t$	Student's $t$ -distributed test statistic
$W$	Shapiro-Wilks test statistic
$x$	a value of the net state variable
$y$	a value of the response variable
$\bar{y}_b$	arithmetic mean of measured responses from the basic state
$\bar{y}_a$	arithmetic mean of measured responses of an actual state (test sample)
$y_c$	critical value of the response variable
$y_j$	$j$ th measurement of the response at a particular level and in a particular series
$y_0$	expectation of the response variable for zero value of state variable
$z$	standardized normal random variable with respect to its quantile
$\alpha$	significance level (i.e. probability of an error of the first kind)
$1 - \alpha$	confidence level
$\nu = J - 1$	degrees of freedom of $t$ -statistic or $\chi^2$ -statistic
$\sigma$	actual standard deviation
$\sigma_0$	actual standard deviation at zero level of state variable
$\sigma_b$	actual standard deviation of the response variable for zero value of the state variable (blank matrix or control)
$\chi^2$	chi-squared random variable

## Annex B (informative)

### Examples

#### B.1 Example 1

Measurement of the mass fraction of cadmium in a BCR soil sample using atomic emission after digestion in *aqua regia*.

0,5 g samples of CRM 142 light sandy soil were analysed for cadmium, known from other data to be present at a level below the critical limit of the measurement method being reported here (at about one-tenth of the limit). Samples were concurrently digested with *aqua regia*, in a batch process, filtered and made up to 25 ml for spectroscopy.  $J = 30$  readings were taken as a single run using a 24-channel inductively coupled plasma emission spectrometer measuring cadmium at 226 nm and operated with normal drift correction.

**Table B.1 — Atomic emission of cadmium at 226 nm from samples of CRM 142 soil**

Response					
mV					
2,170	2,211	2,206	2,229	2,215	2,210
2,191	2,189	2,215	2,186	2,183	2,189
2,145	2,159	2,209	2,169	2,194	2,188
2,203	2,192	2,191	2,203	2,175	2,203
2,174	2,193	2,171	2,182	2,178	2,172

Application of several tests for the non-normality of distribution (skewness, kurtosis and Shapiro-Wilks) and tests for outliers (Grubbs single, Grubbs double) indicates no significant deviation from normality.

Student's  $t$ -value (one-tailed), for 29 degrees of freedom and  $\alpha = 0,05$ , is obtained from standard tables as  $t_{1-\alpha}(v) = t_{0,95}(29) = 1,699$ .

The mean of these response values is calculated as  $\bar{y}_b = 2,189\ 8$  mV, and the standard deviation as  $s_b = 0,018\ 6$  mV.

Three replicate measurements had been concurrently made on a similar soil sample and gave responses of 2,177 mV, 2,183 mV and 2,161 mV.

Using Equation (4), the critical value of the response variable for triplicate measurements of an actual sample is calculated as

$$\begin{aligned}
 y_c &= 2,189\ 8 + 1,699 \times 0,018\ 6 \times \sqrt{\frac{1}{30} + \frac{1}{3}} \text{ mV} \\
 &= 2,189\ 8 + 0,019\ 1 \text{ mV} \\
 &= 2,209 \text{ mV}
 \end{aligned}$$

to three decimal places.

The outcome is reported in Table B.2.

**Table B.2 — Critical value of the response variable for cadmium by atomic emission at 226 nm in CRM 142 soil**

Number of replicates of the response variable in the basic state	30
Number of replicates of the response in the actual state	3
Value of $\alpha$ chosen	0,05
Mean of the response variable in the basic state	2,189 8 mV
Mean of the response of the actual state	2,173 7 mV
Standard deviation of the response variable in the basic state	0,018 6 mV
Critical value of the response variable $y_c$ derived by the simplified method of this part of ISO 11843 in which no calibration data are used	2,209 mV

The critical value of the response variable was not exceeded and no difference could be shown between the basic state and the concurrent test sample.

NOTE The critical value found is much higher than that for the total process using reagents only (for which it is 0,815 mV) and very much higher than that claimed by the instrument manufacturer for the cadmium ion in “pure” aqueous solution (about 0,027 mV) and illustrates the considerable effects that the matrix of the sample may have on the critical value.

Acknowledgement: The above data were supplied by the Soil Science Department of the IACR, Rothamsted, Harpenden, Hertfordshire, UK.

## B.2 Example 2

Chemical oxygen demand in water using a titration method.

It should be noted that the calibration curve for this procedure for measuring the chemical oxygen demand in water is monotonic decreasing: as the amount of oxygen demand increases, the amount of available oxygen decreases so that the volume of ammonium iron(III) sulfate solution used in the back-titration decreases.

Thirty blanks were measured for the determination of the chemical oxygen demand (COD) of water in terms of millilitres of the 0,060 mol/l ammonium iron(III) sulfate solution used for the titration (see Table B.3).

**Table B.3 — Chemical oxygen demand in water by titration**

Volume of solution used for titration					
ml					
19,77	19,71	19,77	19,94	19,92	19,84
19,77	19,71	19,77	19,91	19,95	19,88
19,78	19,71	19,85	19,94	19,94	19,77
19,78	19,80	19,85	19,91	19,94	19,76
19,76	19,83	19,78	19,91	19,83	19,80

Application of several tests for non-normality of distribution (skewness, kurtosis and Shapiro-Wilks) and for outliers (Grubbs single and Grubbs double) indicates slight deviation from normality: the kurtosis test fails for  $\alpha = 0,01$  ( $b_2 = 1,737$  versus critical values of 1,79 and 5,12) and the Shapiro-Wilks test fails for  $\alpha = 0,05$  ( $W = 0,904 5$  versus critical values of 0,900 at  $\alpha = 0,01$  and 0,927 at  $\alpha = 0,05$ ). The distribution of the raw data

can be described as near-normal as two of the tests indicate normality. However, even a simple frequency distribution plot indicates that there is a possibility that the results belong to two distributions. Consequently, in practice it could be advisable to return to the laboratory supplying the data to ascertain whether there has been some irregularity in recording the response variable data. If it is decided that the data are an accurate record, the calculation of the critical value of the response variable for a single determination of an actual (test) sample would be as follows:

The mean of these response values is calculated as  $\bar{y}_b = 19,829$  ml and the standard deviation as  $s_b = 0,077 4$  ml.

Student's  $t$ -value (one-tailed), for 29 degrees of freedom and  $\alpha = 0,05$ , is obtained from standard tables as  $t_{1-\alpha}(v) = t_{0,95}(29) = 1,699$ .

When using Equation (5), the decreasing nature of the calibration requires the variance term to be subtracted from the mean response of the basic state (rather than added to it) so that the critical value of the response variable for single measurements of an actual sample is

$$\begin{aligned} y_c &= 19,829 - 1,699 \times 0,077 4 \times \sqrt{\frac{1}{30} + 1} \text{ ml} \\ &= 19,829 - 0,133 7 \text{ ml} \\ &= 19,70 \text{ ml} \end{aligned}$$

to two decimal places.

The outcome is therefore as reported in Table B.4.

**Table B.4 — Critical values of the response variable for chemical oxygen demand in water by titration**

Number of replicates of the response variable in the basic state	30
Number of replicates of the response of an actual state	1
Value of $\alpha$ chosen	0,05
Mean of the response variable in the basic state	19,829 ml
Standard deviation of the response variable in the basic state	0,077 4 ml
Critical value of the response variable $y_c$ derived by the simplified method of this part of ISO 11843 in which no calibration data are used	19,70 ml

Since the titre of 0,060 mol/l ammonium iron(III) sulfate for an actual (test) sample is not lower than 19,70 ml, there is no difference between the basic state and the concurrent test sample.

Acknowledgement: The above data are cited from an ISO/TC 147, *Water quality*, document.

(Continued from second cover)

<i>International Standard</i>	<i>Corresponding Indian Standard</i>	<i>Degree of Equivalence</i>
repeatability and reproducibility of a standard measurement method	determination of repeatability and reproducibility of a standard measurement method	
ISO 11843-1 : 1997 Capability of detection — Part 1: Terms and definitions	IS/ISO 11843-1 : 1997 Capability of detection: Part 1 Terms and definitions	Identical
ISO 11843-2 : 2000 Capability of detection — Part 2: Methodology in the linear calibration case	IS/ISO 11843-2 : 2000 Capability of detection: Part 2 Methodology in the linear calibration case	do

The technical committee responsible for the preparation of this standard has reviewed the provisions of the following referred standards and has decided that they are acceptable for use in conjunction with this standard:

<i>International Standard</i>	<i>Title</i>
ISO 3534-2 : 1993	Statistics — Vocabulary and symbols — Part 2: Statistical quality control
ISO 3534-3 : 1999	Statistics — Vocabulary and symbols — Part 3: Design of experiments
ISO 11095 : 1996	Linear calibration using reference materials
ISO Guide 30 : 1992	Terms and definitions used in connection with reference materials

Annex A gives a list of symbols used in this standard and is for normative reference whereas Annex B is for information only.



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## Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard alongwith amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

This Indian Standard has been developed from Doc No.: MSD 3 (357).

### Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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